lie hidden." Much has been written of vascular disequilibrium, and of endocrine disturbances, and others as a basis of neuroses. This would seem to be a fertile field for study. It has been possible in a series of cases at the Stanford clinics to demonstrate that while through the usual psychological modes of attack, interesting and more simple psychogenic mechanisms were developed, nevertheless it was only necessary to continue examinations along other lines to find that at the basis of the psychological pathology there appeared to be a definite endocrine dysfunction, and other morbid condition.

The practical side of a communication of this sort would be a consideration of certain of the data looking towards more uniformity in medical opinion, and certain of lines of future investigation.

Experience at the Stanford Clinics would seem to indicate that had more than perfunctory examination been made in many of the supposedly psychogenic disorders, certain physical pathology would have been found. How seldom, with the reports of cases treated and "cured" by psychotherapeutic means, has there been a report of the complete physical status? When the psychoanalyst has found a disturbed sexual psychology in the conscious or less conscious realms, as the basis for certain symptoms, he may need only go a step further and find thyroid or ovarian dystrophy or some other very definite pathology as the probable cause.

Differential symptomotology should be worked out as between the frank and less frank organic conditions, the latter of which have been termed functional.

Surveys should be made of the after-histories of accident cases thought to have been settled by the "lump sum closure method."

Early complete examinations should be made in order to detect localizing organic signs which may later disappear.

Experimental work on animals should be continued as regards injuries to the nervous system following physical trauma with or without external evidences of injury.

It has been the aim of this paper to be expository of attitudes rather than argumentative for one or another school. It has been read in the hope that the discussion may indicate lines of investigation which might lead to greater understanding among physicians as to the roles of organic and psychological factors and their interrelations.

CLINICAL EXPERIENCE AS TO THE SEVERAL KINDS OF PHYSIOTHERAPY EMPLOYED IN RECONSTRUCTION WORK*

[From the Orthopedic Department of the University of California Medical School]

By JAMES T. WATKINS, M. D., San Francisco

A witty Irishman once remarked to the writer that all surgery could be described in three words —"You find a thing and you cut it or tie it. Now, medicine," he continued, "is a much more difficult subject. It takes four words to describe all medicine. You dilate, you contract, you modify nutrition." Now, without pausing to argue with our internal medicine friends, whether by means of their materia medica they can do *more* than dilate, contract and modify nutrition, we can assert with considerable certainty that this is a very fair definition of the fundamental workings of physiotherapy. By it, beyond a question of a doubt, you can dilate, you can contract, and you can modify nutrition. Or, to put it differently, you may say by physiotherapy you can stimulate, you can soothe, and you can augment metabolism.

We, as industrial surgeons, are interested in physiotherapy in its application toward improving the function of the motor apparatus. Now, function is essential to the well-being of our organs of locomotion; when for any reason they are put out of commission they suffer in all their parts—bones become demineralized, muscles atrophy, the venous and lymphatic systems become turgid, motor nerves lose in part their power of transmitting definite selective motor impulses.

But, in order to permit reparative processes to proceed, or at times because of actual damage to some factor essential to locomotion (and under this heading I would include the upper as well as the lower extremities and the supporting structures of the trunk), it happens that function has to be excluded.

Now, the purpose of physiotherapy is to maintain as nearly as possible that state of being in a disabled part which would be normally brought about by function, and later, after the immediate repair of injury, to restore lost function.

Physiotherapy, in one form or another, was employed by the ancients; witness Thermae of the Greeks, and even savages, who had not yet entered into that higher stage of social evolution which we designate barbarism, employ it; such, for example, were the massage methods of the Maories of New Zealand, and the hot sweats and contrast baths of the North American Indian. But among ourselves, while not unknown, it did not come into its own until the reconstruction problems of the war forced upon us its more general recognition. One reason for this delayed recognition lay in the fact that most of those among us who practiced it were persons too imperfectly educated in critical medicine to be able to differentiate pathological processes, or to record physical findings, had they been minded to make them—which, incidentally, they were not. Often they were honest enough, but possessed of that mystical order of mind typified in Wilde's character, who exclaimed, "I can believe anything so long as it is incredible."

Fortunately, for industrial surgery, the war sent practically the whole medical profession into the army, and concentrated the best medical thought of the age upon the problem of the reconstruction of the crippled soldier. Only then did the great value of treatment by physical means receive general recognition. And now, in the third year after the war, when no doctor's office seems complete without its therapeutic aid, one begins to wonder has not the pendulum swung back too far—are we not in danger of asking too much of physiotherapy?

* Read before the Fiftieth Annual Meeting of the Medical Society of the State of California, Coronado, May, 1921.

In saying this I would not for an instant be classed with that group of congenital reactionaries who will have none of it, because physiotherapy is not yet upon what they are pleased to term a "scientific footing." According to these intellectual negations, physiotherapy is in the same stage of development that obtained with the poly drug therapy of fifty years ago. When it attains to the scientific accuracy of the mono-drug therapy of today, should it ever do so, then they will embrace it.

Now, all this reasoning is defective on two separate counts. First, the really efficient drug therapy is *specific*—clinically, we know that it acts on a given diseased tissue in a certain way, but we do not know *why* nor *how* it acts.

Aconite would appear to be a specific for simple inflammations of the pharynx, the metal antimony a specific for simple catarrhal inflammations of the larynx, which is two inches away, and ipecac, a specific for simple catarrhal inflammations of the bronchi, which are two inches lower down still. Mercury is a specific for a special type of small, round cell degenerative inflammation, which we designate as gumma. But *how* or *why* these specifics act *as* they do, *where* they do we *simply do not know*. On the other hand, I can say with equal certainty that a hot pack followed by appropriate massage is just as much a specific for a lame back, consequent upon excessive muscular effort, as is the best of them for its special disorder. And I can put forward a much more likely hypothesis—a much more nearly scientific reason, in other words—as to why and how it accomplishes its result.

Second. Scientific knowledge is, as a rule, not the result of pure reason—the outcome of an intellectual tour de force. It does not spring like Minerva, fully armed from the head of Jove. On the contrary, oftener than not, objective phenomena are accurately observed, and then by deduction the fundamental laws which activate them are uncovered. Sir Isaac Newton achieved immortality by defining the mighty laws of gravitation; but, if we are to accept tradition, what started him thinking was the humble, objective, clinical observation of an apple falling out of a tree.

Physiotherapy is a treatment department only. Its sphere of action is to supplement the technic of the surgeon, the materia medica of the physician, the appliances of the orthopedist. It is the applied physics of the healing art, and includes massage, manipulation, curative exercises, hydro-thermo-photo-electro and mechano-therapy, and occupational therapy. And each separate type when differently administered may produce opposite effects.

It is not enough to prescribe electricity, for example, or even a type of electricity, such as galvanism or diathermy. Its intelligent prescription implies a knowledge of the indicated volume or amperage under what pressure or voltage for what period of time as applied to each individual case—and along with it a clear-cut note recording what it is intended to do, and frequent comments in the case history as to whether or not the anticipated result is being accomplished.

In entering upon a discussion of physiotherapy as it is applied to industrial surgery, we must recognize at the outset, *first,* that thus far we use only a few of the remedial measures which can properly be included under this grouping, and *secondly,* that we possess very little knowledge of the *actual* workings of those few measures that we do use.

It is fairly certain that at times some of them we misuse, a fact which is equally true of drug therapy. The future of physiotherapy lies in the care with which we watch our cases, the accuracy with which we record our results, both good and bad, the thoroughness with which we divest our minds of prejudice—either pro or con.

I am sure you will appreciate that in the few minutes allotted to any one paper by the program committee, there is time only for the briefest possible review of what we believe to be the facts regarding the more generally employed physical therapeutic agents. Did I attempt more, our tyrannical chairman would stop me.

And First of Massage.—Generally administered massage, probably through its influence on the vaso-motor apparatus, causes a dilatation of the blood vessels, certainly near the surface and possibly deeper in the body, thereby taking a load off the heart. It empties waste products of metabolism into the general ciculation, and thereby augments their elimination through the organs of excretion.

It very greatly diminishes the excitability of the end of corpuscles of superficial sensation.

Locally, massage empties the venous and lymphatic circulations, stimulates skin elimination, and empties the ducts of the skin glands, supports local metabolism, loosens adhesions and the products of inflammation.

Manipulation.—This potentially dangerous but useful modality (passive movements) should be employed with extraordinary care to prevent muscle shrinkage from constant relaxation, to prevent the organization into fibrous structures of inflammatory infiltration into the tissues and to overcome limitation of motion at a joint when caused by these conditions.

Passive movements should *not* be employed before union had been established in the long bones or in such a way as to disturb the relations of fragments of bone in the neighborhood of joints.

When the limitation of motion is present in a joint of a traumatized limb, forced passive movements, cautiously graded, may be employed to overcome the functional defect. Here it should be noted that when swelling, induced by manipulation, persists for more than twenty-four hours, the limb should be given further rest, and when manipulations are resumed they should be milder in character than those previously resorted to.

Hydrotherapy.—Hydrotherapy may be used in a variety of ways. 1. In instituting a weak motion. We know Archimedes law that when submerged a body loses weight corresponding with the weight of the volume of water it displaces. Naturally, motions can be carried out under such conditions through a much less expenditure of effort than would otherwise be the case.

When submerged the limb is subjected to the surface pressure of water, which is estimated at 62½ pounds to the square inch, whereas at the sea level atmospheric pressure is but fifteen pounds to the square inch.

Cold limbs previously submerged in water at a temperature of 95 to 102 degrees Fahrenheit for twenty minutes, sustain a dilatation of their capillaries, which obtains for several hours and must aid in improving the nutrition of the parts.

Generally speaking, the action of hydrotherapy may be either stimulating or soothing; because it offers the best means of applying, in an absolutely controlled dosage, heat and cold to the body surface. It may be sedative when employed in the so-called sedative pool bath, which may, in neurasthenics, be protracted for hours and combined with massage and passive movements. Or, it may be employed in the form of the whirlpool bath to parts too sensitive for massage. Here it combines heat and a form of very gentle frictional massage. It exerts an admirable influence upon sluggish wounds, and often prepares the way for more formal massage treatments.

Thermotherapy.—Heat is either convective, conductive, or conversive.

Convective Heat.—It is contended by some writers that radiant light and heat has advantages over simple convective heat, in that light penetrates into the tissues much further than simple heat, and is there transformed into heat, as is all arrested energy.

This may be so, particularly when the quartz lamp is used, but in our experience at the Hahnemann Hospital, moist heat in the form of the hot pack, as a preliminary to massage or to relieve pain following manipulation, has been unquestionably more efficacious.

Because opinions on this point differ, a critical study of results by a series of observers will have to be made before a definite conclusion can be come at.

Conductive Heat.—E. g., by hot water bottles, etc., has little or no place in physiotherapy.

Conversive Heat.—Conversive heat may be generated in the tissues themselves by the passage through them of a relatively large volume of current (amperage) under low pressure or intensity, that is voltage, obtained from the primary windings of a Tesla transformer in a high frequency machine. Heat so generated is known to us as the direct d'Arsonval current or diathermy or thermal infiltration or thermal penetration. They all mean the same thing.

It is a law of physics that energy opposed is converted into heat. So when this current of large volume low-pressure electricity is passed through anything, it naturally generates heat in proportion as it encounters resistence in passing from one electrode to the other; and, while the amount of current is absolutely under the control of the operator, the greatest heat is generated at the site where the current encounters the most resistance. Therefore, more heat is developed in bone callus or dense adhesions than in the soft parts of a limb. Properly used it is painless except in the presence of a foreign body in the tissue or a corroded spark gap.

Electrotherapy.—In physiotherapy the effects of electricity may be said to be chemical, mechanical, thermal and electronic. The galvanic current or galvanism, is a direct continuous current, the effects of which are chemical, the negative pole which most interests us is stimulant, attracts hydrogen, and is, therefore, alkaline in reaction, is a vaso-dilator. The positive pole is the reverse of the negative pole. In industrial surgery, galvanism is best used to soften scars by forcing the chlorine ion of sodium chloride into the tissues. The slow galvanic sinusoidal current is employed to cause muscle stimulation after paralysis. It is simply a galvanic current mechanically made into a wave form.

While the galvanic current obtains chemical effects, the static and induced currents exert their influence mechanically. They cause a muscle to contract, and thus mechanically can exert a therapeutic effect.

High Frequency Currents.—To understand the physics of high frequency currents, one writer (Sampson) uses the following simile: Imagine a stream of water six inches in diameter, with a thousand pounds to the inch pressure. This would correspond to a high amperage, high voltage electrical current.

Such a stream of water would kill a man instantly, or tear great holes in rocky mountainsides. But if such a stream of water could be put through a nebulizer so as to be converted into a fine mist that would float in the air, it could be used to moisten the most delicate flowers.

In like manner a high amperage high voltage electrical current, many times greater than sufficient to kill, when passed through a high frequency apparatus can be made safe for human beings, and can be employed with beneficent results.

I imagine this is a fairly good simile. I know that in my own experience, a high frequency machine, which had been employed for years without mishap, sustained a breakdown of the insulation between the primary and secondary of the transformer, with the result that when there was an accidental contact made with one of the binding posts, the operator was instantly electrocuted.

With regard to its indications, I have repeatedly been surprised at the way in which indefinite pains about joints cleared up under "high frequency."

Ultra Violet Ray.—The ultra violet ray we know less about still. We have seen it abate superficial infective processes, like carbuncles, and apparently cure neuritis.

Static.—Static is said to do the same thing for sciaticas. I have no personal experience of it, however.

Mechano-therapy.—A Swede named Zander, first devised a system of resistance apparatus designed to afford resistance exercises for all possible motions of the extremities and trunk. Herz, of Berlin, produced a refinement of the Zander group by determining the power curve of each muscle group, and making his resistance force follow this curve. That is your resistance, weak at the beginning of a motion, gradually increased to the point where maximum force could be exerted

in a given motion, and then diminished again as the power itself decreased.

The advantage of these types of mechano-therapeutic apparatus lies in the fact that the dose, so to speak, can be accurately prescribed, and is constant. Resistance exercises administered by an individual vary with the momentary physical condition of the person giving them.

Another type of apparatus is the Kruckenberg pendulum group. Here a limb is strapped to the apparatus in such a way that the axis of joint motion is identical with the axis of a weighted pendulum. When the latter is set in motion it carries the limb with it, thereby gradually increasing its arc of motion.

I worked a good deal with these several types of apparatus during my student-years in Europe. They are expensive, get easily out of order, and the work with them soon becomes monotonous to both patient and director.

And now, when I have scarcely touched on one part of my subject, and upon the rest of it not at all, my time is already over-stepped.

In closing, I would leave with you this thought, which not only includes the gist of my argument, but was the real reason for my writing this paper.

To no man, who seeks it humbly, is the truth ever wholly hid. And so, if we observe and record, without prejudice and without favor, our experiences in physiotherapy, in time from the mass of our clinical findings, the real principles of physical treatment, its indications and its limitations will become progressively clearer to us, till, from the anxious or credulous empiricism of the past shall emerge the exact science of tomorrow.

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FRACTURED FEMURS *

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The literature regarding fractured femurs is very extensive. Nevertheless, the review of certain basic principles, especially in their application to industrial surgery, will perhaps not be amiss, especially when one remembers that the treatment of a fractured femur is one of the MAJOR PROBLEMS OF SURGERY.

From a purely statistical viewpoint, how much more serious than many other surgical conditions is the fractured femur. A simple appendectomy heals in seven to ten days, a suppurative one in six to ten weeks; a cholecystectomy is cured in six weeks, or, if drained, in ten to twelve weeks at the utmost; intestinal anastomosos, or gastro-enteric-anastomosis are restored to function in three to six weeks, while a well-treated fractured femur requires six months before the patient may resume his occupation.

As Sir Robert Jones has said that "Fractured femurs were the great calamity of the war." They are also the great problem of industrial warfare.

Fractures of the femur can be classified in two general ways:

1. According to the extent of the lesion, as (a) Simple or (b) Compound.
2. Anatomically as (a) of the upper third; (b) of the middle third; (c) of the lower third.

Certain essential objectives must be kept in view in the treatment of all of them. Briefly stated, they are:

1. The attainment of complete reduction, if possible.
2. Firm, bony union.
3. Keeping the correct relations of the anterior planes of the upper and lower fragments.
4. The prevention of shortening (a good result, according to the report of the Fracture Committee of the American Surgical Committee, should show no shortening of over one-eighth to one inch).
5. Prevention of lameness, due to knee stiffness or shortening.
6. The restoration of the patient to efficiency as a workman, in the minimum time commensurable with proper union. This can seldom be attained in less than six months.

As basic principles of treatment, to gain these results, the following two rules should be axiomatic:

1. The distal fragment is the mobile one and must, by one method or the other, be brought into axial relationship with the proximal fragment and maintained there.
2. The limb must be put into the posture of neutral muscle pull. There will then be less tendency to displacement.

Two other fundamental principles that are of tremendous importance should be recognized:

1. Frequent X-ray examination should be the rule. Fragments slip, traction is not sufficient; mal-formation is the result. The X-ray will readily demonstrate such a defect.
2. Whenever a fracture is put up in traction, such as obtained by a Thomas splint, daily inspection of the conditions present should be made. The mere application of a traction apparatus is only the beginning of the treatment. The painstaking subsequent after-care of these fractures is the only sure way of obtaining proper results.

At all times the surgeon should familiarize himself with the anatomy of the region involved in the fracture, and the various forces acting upon the fragment, and be ready to adapt new principles to bring about results. Certain definite facts are common to the treatment of each region, and it is from this viewpoint that the treatment of the individual fractures will be considered. This will explain certain apparent omissions of methods that have been effectual with other workers.

First-Aid Treatment:—The treatment should be begun as soon as possible after the injury. Proper emergency care means the prevention of deformity and bleeding into the muscles and fascial planes, with subsequent hematoma, myositis, or nerve injury. This is best effected by the early use of the Thomas splint, that is, prior to any attempt at transportation of the injured individual.

The splint should be applied over the clothing and immediate traction begun. This can be effected by one of two methods:

(a) By splitting laterally through the uppers

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